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UTILITY PATENT APPLICATION TRANSMITTAL
(Only for new nonprovisional applications under 37 CFR 1.53(b))**Attorney Docket No.** 004259.P009

(maximum 12 characters)

First Named Inventor Stephen G. Perlman**Title:** Apparatus And Method For Intelligent Multimedia Compression And Distribution**Express Mail Label No.** EL627465049US**ADDRESS TO:** Assistant Commissioner for Patents
Box Patent Application
Washington, D. C. 20231**APPLICATION ELEMENTS**

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ **Fee Transmittal Form (e.g., PTO/SB/17)**
(Submit an original, and a duplicate for fee processing)
2. ☐ **Applicant Claims Small Entity Status. (37 CFR 1.27)**
3. ☒ **Specification (Total Pages 36)**
(preferred arrangement set forth below)
 - Descriptive Title of the Invention
 - Cross Reference to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference sequence listing, a table, or a computer program listing appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure
4. ☒ **Drawings(s) (35 USC 113) (Total Sheets 10)**
5. ☒ **Oath or Declaration (Total Pages 5)**
 - a. ☒ Newly Executed (Original or Copy)
 - b. ☐ Copy from a Prior Application (37 CFR 1.63(d))
(for Continuation/Divisional with Box 17 completed)
 - i. ☐ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
 - c. ☐ Unsigned.
6. ☐ **Application Data Sheet. (37 CFR 1.76)**
7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program (Appendix)
8. ☐ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
 - a. ☐ Computer Readable Form (CRF)
 - b. ☐ Specification Sequence Listing on:
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- 1 -

004259.P009

JC535 U.S. PTO
11/22/00JC535 U.S. PTO
09/21/56
11/22/00

ACCOMPANYING APPLICATION PARTS

9. ☒ **Assignment Papers (cover sheet & documents(s))**
10. ☐ a. Separate 37 CFR 3.73(b) Statement (where there is an assignee)
- ☐ b. Power of Attorney
11. ☐ English Translation Document (if applicable)
12. ☐ a. Information Disclosure Statement (IDS)/PTO-1449
- ☐ b. Copies of IDS Citations
13. ☐ **Preliminary Amendment**
14. ☒ **Return Receipt Postcard (MPEP 503) (Should be specifically itemized)**
15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. ☐ Request and Certification under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. ☐ Other: _____

18A. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP)
Of Prior Application No.: _____ Examiner _____ Group Art Unit _____

(which is a ☐ continuation/ ☐ divisional/ ☐ CIP of prior application no. _____,
which is a ☐ continuation/ ☐ divisional/ ☐ CIP of prior application no. _____) (List entire chain of priority)

For CONTINUATION AND DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

18B. Statement under 37 CFR 3.73(b) for continuing application:

The undersigned states that _____ (name of assignee) is the assignee of the entire right, title, and interest in the accompanying patent application by virtue of an assignment recorded in the Patent and Trademark Office at Reel. No. _____ Frame No. _____ (or a copy of which is attached).

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FEE TRANSMITTAL FOR FY 2001**TOTAL AMOUNT OF PAYMENT (\$)** 1584.00**Complete if Known:**Application No. Not Yet AssignedFiling Date Herewith

First Named Inventor _____

Group Art Unit Not Yet AssignedExaminer Name Not Yet AssignedAttorney Docket No. 004259.P009**METHOD OF PAYMENT (check one)**

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number 02-2666
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☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status. See 37 CFR 1.27

2. X Payment Enclosed: X Check
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FEE CALCULATION**1. BASIC FILING FEE**

Large Entity		Small Entity		Fee Description	Fee Paid
Code	Fee (\$)	Code	Fee (\$)		
101	710	201	355	Utility application filing fee	<u>\$710.00</u>
106	320	206	160	Design application filing fee	_____
107	490	207	245	Plant filing fee	_____
108	710	208	355	Reissue filing fee	_____
114	150	214	75	Provisional application filing fee	_____

SUBTOTAL (1) \$ 710.00**2. EXTRA CLAIM FEES**

Total Claims		Extra Claims	Fee from below	Fee Paid
<u>53</u>	- 20** =	<u>33</u>	X <u>\$18.00</u>	= <u>\$594.00</u>
Independent Claims <u>6</u>	- 3** =	<u>3</u>	X <u>\$80.00</u>	= <u>\$240.00</u>
Multiple Dependent				= _____

**Or number previously paid, if greater; For Reissues, see below.

Large Entity		Small Entity		Fee Description
Code	Fee (\$)	Code	Fee (\$)	
103	18	203	9	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	80	209	40	**Reissue independent claims over original patent
110	18	210	9	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) \$ 834.00

FEE CALCULATION (continued)

3. ADDITIONAL FEES

<u>Large Entity</u>		<u>Small Entity</u>		<u>Fee Description</u>	<u>Fee Paid</u>
<u>Code</u>	<u>Fee (\$)</u>	<u>Code</u>	<u>Fee (\$)</u>		
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for ex parte reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	390	216	195	Extension for reply within second month	
117	890	217	445	Extension for reply within third month	
118	1,390	218	695	Extension for reply within fourth month	
128	1,890	228	945	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,240	241	620	Petition to revive - unintentional	
142	1,240	242	620	Utility issue fee (or reissue)	
143	440	243	220	Design issue fee	
144	600	244	300	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	130	123	130	Petitions related to provisional applications	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	\$40.00
146	710	246	355	For filing a submission after final rejection (see 37 CFR 1.129(a))	
149	710	249	355	For each additional invention to be examined (see 37 CFR 1.129(b))	
179	710	279	355	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	
Other fee (specify) _____					
Other fee (specify) _____					

SUBTOTAL (3) \$ 40.00

*Reduced by Basic Filing Fee Paid

SUBMITTED BY:

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Telephone Number: 408-720-8300

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04259.P009

Patent

UNITED STATES PATENT APPLICATION

for

APPARATUS AND METHOD FOR INTELLIGENT
MULTIMEDIA COMPRESSION AND DISTRIBUTION

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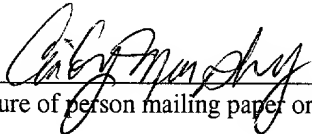
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APPARATUS AND METHOD FOR INTELLIGENT MULTIMEDIA COMPRESSION AND DISTRIBUTION

BACKGROUND

5 Field of the Invention

This invention relates generally to the field of multimedia systems. More particularly, the invention relates to a improved multimedia system for compressing and decompressing multimedia content and data using a mass storage device.

10 Description of the Related Art

A prior art system for receiving and storing an analog multimedia signal is illustrated in **Figure 1a**. As illustrated a selector 107 is used to choose between either a baseband video input signal 102 or a modulated input signal 101 (converted to baseband via a tuner module 105). A digitizer/decoder module 110 performs any necessary decoding of the analog signal and converts the analog signal to a digital signal (e.g., in a standard digital format such as CCIR-601 or CCIR-656 established by the International Radio Consultative Committee).

An MPEG-2 compression module 115 compresses the raw digital signal in order to conserve bandwidth and/or storage space on the mass storage device 120 (on which the digital data will be stored). Using the MPEG-2 compression algorithm, the MPEG-2 compression module 115 is capable of compressing the raw digital signal by a factor of between 20:1 and 50:1 with an acceptable loss in

video image quality. However, in order to compress a standard television signal (e.g., NTSC, PAL, SECAM) in real-time, the MPEG-2 compression module 115 requires approximately 8 Mbytes of RAM 116 (typically Synchronous Dynamic RAM or “SDRAM”). Similarly, after the video data has been compressed and
5 stored on the mass storage device 120, the prior art system uses an MPEG-2 decompression module 130 and approximately another 8 Mbytes of memory 116 to decompress the video signal before it can be rendered by a television 135.

Prior art systems may also utilize a main memory 126 for storing instructions and data and a central processing unit (“CPU”) 125 for executing the
10 instructions and data. For example, CPU may provide a graphical user interface displayed on the television, allowing the user to select certain television or audio programs for playback and/or storage on the mass storage device 120.

A prior art system for receiving and storing digital multimedia content is illustrated in **Figure 1b**. Although illustrated separately from the analog signal
15 of **Figure 1a**, it should be noted that certain prior art systems employ components from both the analog system of **Figure 1a** and the digital system from **Figure 1b** (e.g., digital cable boxes which must support legacy analog cable signals).

As illustrated, the incoming digital signal 103 is initially processed by a
20 quadrature amplitude modulation (“QAM”) demodulation module 150 followed

by a conditional access ("CA") module 160 (both of which are well known in the art) to extract the underlying digital content. As indicated in **Figure 1b**, the digital content is typically an MPEG-2 multimedia stream with a compression ratio selected by the cable TV or satellite company broadcasting the signal. The MPEG-2 data is stored on the mass storage device 120 from which it is read and decompressed by an MPEG-2 decompression module 130 (typically using another 8 Mbytes of RAM) before being transmitted to the television display 135.

One problem associated with the foregoing systems is that the memory and compression logic required to compress and decompress multimedia content in real time represents a significant cost to manufacturers. For example, if 8 Mbytes of SDRAM costs approximately \$8.00 and each of the compression and decompression modules cost approximately \$20.00 (currently fair estimates), then the system illustrated in **Figure 1a** would require \$56.00 to perform the compression/decompression functions for a single multimedia stream. Moreover, considering the fact that many of these systems include support for multiple multimedia streams (e.g., two analog streams and two digital streams), the per-unit cost required to perform these functions becomes quite significant.

Another problem with the digital system illustrated in **Figure 1b** is that it does not allow users to select a particular compression level for storing multimedia content on the mass storage device 120. As mentioned above, the compression ratio for the MPEG-2 data stream 170 illustrated in **Figure 1b** is

selected by the digital content broadcaster (e.g., digital cable, satellite, Webcaster,
... etc). In many cases, however, users would be satisfied with a slightly lower
level of video quality if it would result in a significantly higher MPEG-2
compression ratio (and therefore more available storage space on the mass
5 storage device).

Accordingly, what is needed is a more efficient means for compressing
and decompressing multimedia content on a multimedia storage and playback
device. What is also needed is an apparatus and method which will allow users
to select a compression ratio and/or compression type suitable to their needs
10 (e.g., based on a minimum level of quality given the capabilities of their mass
storage devices).

SUMMARY OF THE INVENTION

A multimedia apparatus is described comprising: a mass storage device to store uncompressed and compressed multimedia content; and compression logic executed by a processor, the compression logic configured to store

5 uncompressed multimedia content in an interim multimedia buffer on the mass storage device, compress the uncompressed multimedia content as a background task to generate compressed multimedia content, and store the compressed multimedia content in long term multimedia buffer on the mass storage device.

Also described is a computer-implemented method for decreasing the cost
10 of a multimedia storage device comprising: storing multimedia content in an interim multimedia buffer on a mass storage device before compressing the multimedia content; compressing the multimedia content as a background task to generate compressed multimedia content responsive to a user request to record the multimedia content; and storing the compressed multimedia content
15 in long term multimedia buffer on the mass storage device.

Also described is a method implemented on a multimedia storage apparatus comprising: storing digital multimedia content in an interim storage buffer at a first compression ratio, the first compression ratio being the ratio at which the digital multimedia content was transmitted by a multimedia content
20 broadcaster; decompressing the multimedia content; recompressing the multimedia content at a second compression ratio specified by a user, the second

compression ratio being higher than the first compression ratio; and storing the recompressed multimedia content in a long term storage buffer.

Also described is a method implemented on a multimedia storage apparatus comprising: storing digital multimedia content in an interim storage buffer at a first compression type, the first compression type being the type at which the digital multimedia content was transmitted by a multimedia content broadcaster; decompressing the multimedia content; recompressing the multimedia content using a second compression type specified by a user to create recompressed multimedia content; and storing the recompressed multimedia content in a long term storage buffer.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention can be obtained from the following detailed description in conjunction with the following drawings, in which:

5 **FIGS. 1a and 1b** illustrate prior art multimedia storage and playback systems.

FIG.2 illustrates one embodiment of a system for intelligent multimedia compression and distribution.

10 **FIG. 3** illustrates coordination between compressed and uncompressed multimedia data according to one embodiment of the invention.

FIG. 4 illustrates one embodiment of the invention employing a light compression algorithm.

FIG. 5 illustrates one embodiment of the invention for performing data compression conversion on a digital multimedia signal.

15 **FIG. 6** illustrates compressed and uncompressed buffer coordination according to one embodiment of the invention.

FIG. 7a-c illustrate embodiments of the invention which employ compression algorithms adapted to be executed in real time using a general purpose processor.

20

DETAILED DESCRIPTION

In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, to one skilled in the art that the invention may be practiced without some of these specific details. In other instances, well-known structures and devices are shown in block diagram form to avoid obscuring the underlying principles of the invention.

EMBODIMENTS OF AN APPARATUS AND METHOD FOR INTELLIGENT MULTIMEDIA COMPRESSION AND DISTRIBUTION

As shown in **Figure 2**, one embodiment of the invention is comprised of one or more tuners 105 for converting an incoming analog signal to a baseband analog signal and transmitting the baseband signal to a decoder/digitizer module 110. The decoder/digitizer module 110 decodes the signal (if required) and converts the signal to a digital format (e.g., CCIR-601 or CCIR-656 established by the International Radio Consultative Committee).

Unlike prior art systems, however, the system illustrated in **Figure 2** transfers the digital content directly to the mass storage device 120 without passing it through an MPEG-2 (or any other) compression module (e.g., such as module 115 in **Figure 1a**). Accordingly, the mass storage device 120 has enough capacity to handle the incoming uncompressed digital video stream (uncompressed content will take up significantly more space on the mass storage

device 120). In addition, the mass storage device 120 of one embodiment is capable of supporting the bandwidth required by the uncompressed digital video signal. For example, a typical MPEG-2 compressed video signal requires a bandwidth of between 2 Mbits/sec and 5 Mbits/sec, whereas the same signal
5 may require approximately 120 Mbits/sec in an uncompressed format.

Therefore, the mass storage device 120 in one embodiment is coupled to the system via an Ultra DMA-66/Ultra ATA-66 or faster interface (capable of supporting a throughput of up to 528 Mbits/sec), and has a storage capacity of 80 Mbytes or greater (by today's standards). It should be noted, however, that
10 the particular interface type/speed and drive storage capacity is not pertinent to the underlying principles of the invention. For example, various different interfaces such as Small Computer System Interface ("SCSI") may be used instead of the Ultra-ATA/Ultra DMA interface mentioned above, and various different drive capacities may be employed for storing the incoming digital
15 content.

Although the digital content is initially stored in an uncompressed format, in one embodiment of the invention, the CPU 225 works in the background to compress the content by executing a particular compression algorithm (e.g., MPEG-2). Accordingly, referring now to **Figure 3**, if a user chooses to record a
20 particular television program represented by video input 301 (or other multimedia content), it will initially be stored in an uncompressed data buffer 311 on the mass storage device. However, using the MPEG-2 compression

algorithm (or other algorithm as described below), the CPU will work in the background to compress the content and transfer the compressed content to a compressed data buffer 312. Even though the CPU may not have sufficient processing power to compress the incoming data stream in real time (although in some cases it may as described below), it is still capable of compressing the data given a sufficient amount of time to do so (e.g., as a background task). Thus, even a general purpose processor such as an Intel Pentium III®, AMD Althon®, or QED MIPS R5230 processor may be used to compress the multimedia data.

In addition, only a relatively small amount of standard memory 126 is required to perform the compression algorithm due to the fact that, in one embodiment, the system may establish large swap files for working with the multimedia data during the compression and/or decompression procedures (see below). In one embodiment, the swap file configuration may be set by the end user and controlled by an operating system executed on the CPU. For that matter, many of the operations described herein may be scheduled and executed with the aid of a multithreaded, multitasking operating system such as Linux, UNIX, Windows NT®, with realtime and non-realtime multimedia streaming and compression functions built in.

If all of the multimedia content for the multimedia program has been compressed and stored in the compressed data buffer 312 at the time the user attempts to watch the program, then it will be decompressed by the MPEG-2

decompression module 130 before being rendered on the user's television display 136 (represented by signal 342 in **Figure 3**). If, however, the program has not been fully compressed (e.g., a percentage of the data is still stored in the uncompressed data buffer), then the portion of the data which is compressed will initially be transmitted to the user through the MPEG-2 decompression module 130 until all the compressed data has been consumed (i.e., until the compressed data buffer is empty). Once the compressed data is consumed, the remaining portion of the program residing in the uncompressed data buffer will be transmitted directly to the television 136 (represented by bypass signal 220). In other words, because the data is uncompressed it does not need to be processed by the MPEG-2 compression module 130.

In one embodiment, a control program executed by the CPU coordinates the data transmissions between the various compressed/uncompressed data buffers 311, 312 and data transmissions from the data buffers 311, 312 to the end user as described above (e.g., the control program may determine when to switch from the compressed data buffer to the uncompressed data buffer).

When a user chooses to watch a live television program or other live multimedia event such as a Webcast (represented by video input 300), one embodiment of the system transmits the incoming multimedia data to an uncompressed data buffer 310 and from the uncompressed data buffer 310 directly to the television 135 or other multimedia rendering device (i.e., signal

340 in **Figure 3**). Accordingly, in this embodiment, for live broadcast events no multimedia compression or decompression is required. In addition, the uncompressed data buffer 310 may be configured to store a user-specified amount of data from the live broadcast, thereby providing support for real-time

5 “trick modes” such as pause or rewind for live television. The amount of data stored in the uncompressed data buffer 310 for these purposes may be based on the capacity of the mass storage device employed on the system. For example, a typical uncompressed digital video signal will consume approximately 50 Gbytes/hour. As such, if the system illustrated in **Figures 2** and **3** employs a 100

10 Gbyte mass storage device 120, one-quarter of the capacity of the device may be allocated to store ½ hour of live multimedia content with the remaining portion allocated for long term storage (e.g., employing the CPU-based compression techniques described above). In one embodiment, the size of the long term buffer(s) and the live broadcast buffer(s) is configurable by the user. For

15 example, users who have no interest in “trick modes” may allocate all of the mass storage device 120 capacity to long term storage.

In sum, the system described above with respect to **Figures 2** and **3** provides the same features of prior systems (e.g., trick modes and long term storage of multimedia content) but at a significantly lower cost than prior

20 systems due to the fact that it is capable of performing multimedia compression using a general purpose processor in non-realtime and a high-capacity, high speed mass storage device.

A related embodiment of the invention illustrated in **Figure 4** includes a light compression module 410 for compressing the incoming digital signal in real time before the content is stored on the mass storage device 120. The primary difference between the light compression module 410 and the MPEG-2

compression module 115 (**Figure 1a**), however, is that the light compression module 410 requires less memory and processing logic (i.e., silicon gates) to execute its compression algorithm (and is therefore less costly to manufacture).

For example, an adaptive differential pulse code modulation ("ADPCM")

algorithm may be employed with as little as 1280 bytes of memory (because

ADPCM evaluates entropy between adjacent video pixels rather than several adjacent video frames as does MPEG-2). Although ADPCM is not capable of the same level of compression as MPEG-2, it is still capable of compressing a standard NTSC video signal in real time at a ratio of between 3:1 and 4:1. As such, for a nominal additional expense, the ADPCM compression module 410

and corresponding decompression module 420 will increase the effective capacity of the "uncompressed" data buffers 310, 311 illustrated in **Figure 3** by a multiple of between 3x and 4x. In all other respects, the embodiment illustrated in **Figure 4** may be configured to function in the same manner as the

embodiments illustrated in **Figures 2** and **3**. For example, the digital content

stored in an ADPCM-compressed format in buffer 311 may be compressed in the background by the CPU 125 using a more intensive compression algorithm such as MPEG-2 and stored in buffer 312. Similarly, for live broadcasts the ADPCM-

compressed data may be transmitted from data buffer 310 to the light
decompression module 420 for decompression, and then to the user's television
135 (or other multimedia rendering device).

In one particular embodiment, the light compression modules configured
5 in the system provide intra-frame coding/decoding (i.e., compression/coding
within each individual video frame) whereas the standard compression and/or
decompression modules (e.g., MPEG-2 decompression module 130) provide both
inter- and intra-frame coding, using coding techniques *between* successive frames
as well as *within* each frame (e.g., such as motion compensation and frame
10 differencing for MPEG-2). For example, in one embodiment, the light
compression module 410 is configured with the Digital Video ("DV25")
compression algorithm for intra-frame coding (see, e.g., the IEC 61834 digital
video standard). DV25 compression uses a discrete cosine transform ("DCT")
which provides a compression ratio of approximately 5:1. One additional benefit
15 of using DV25 compression in this context is that, because the MPEG-2 module
130 includes DCT logic, the DCT portion of the MPEG-2 decompression module
130 may be used to decompress the DV25-compressed video stream.
Accordingly, if DV25 compression is used, a separate light decompression
module 420 may not be necessary, thereby further reducing system cost. In
20 addition, the CPU may work in the background to compress the multimedia
content using MPEG-2 (which utilizes both inter-frame and intra-frame coding
techniques) to achieve a higher compression ratio for long term storage.

It should be noted that various light compression algorithms other than ADPCM and DV25 may be implemented while still complying with the underlying principles of the invention. In fact, the light compression module 410 may use virtually any compression algorithm which requires less memory and/or fewer silicon gates to implement than the “standard” video compression algorithm used in the system (e.g., such as MPEG-2).

Figure 5 illustrates one embodiment of the invention for compressing and storing a digital multimedia signal 103. The particular embodiment illustrated in **Figure 5** includes a QAM module 150 and a conditional access module 160 for extracting the underlying MPEG-2 data stream 170. The MPEG-2 multimedia stream (or other compressed data stream) is initially stored on the mass storage device 120 as in prior systems. Unlike prior systems, however, the system illustrated in **Figure 5** allows users to specify a data compression ratio other than the compression ratio and/or compression type with which the multimedia content is broadcast. For example, referring also to **Figure 6**, in one embodiment, the MPEG-2 stream is initially transmitted to buffer 611 on the mass storage device 120 at the same compression ratio as which it was transmitted – 20:1. Certain users, however, may be satisfied with a higher compression level (and corresponding decrease in quality) for everyday television viewing. As such, the illustrated embodiment allows the user to select a higher compression ratio such as 40:1 for specified programs (e.g., programs recorded from a satellite broadcast). As indicated in **Figure 5**, the CPU will then work in the background

to convert the 20:1 MPEG-2 video to the 40:1 compression ratio. For MPEG-2-compressed data this means that the CPU will decompress the 20:1 MPEG-2 data to raw data (e.g., CCIR-601) and then recompress the raw data using the 40:1 compression algorithm. For other types of multimedia compression, the system may not need to fully decompress and then recompress the entire signal (i.e., the system may simply convert the signal using a conversion algorithm). Once the conversion process is complete, the multimedia content stored in buffer 612 will take up ½ the space on the mass storage device 120.

When the user selects the recorded program for viewing, it will be streamed to his television from buffer 612, through the MPEG-2 decompression module 130. If, as described above, the entire background process is not complete when the viewer selects the recorded program (i.e., if only a portion of the 20:1 data has been converted to 40:1 data), then the portion of the data which is compressed and 40:1 and stored in buffer 612 will initially be transmitted to the television (or other display device) until all of the 40:1 compressed data has been consumed (i.e., until the compressed data buffer 612 is empty). Once the 40:1 compressed data is fully consumed, the remaining portion of the data residing in the 20:1 compressed data buffer 611 will be transmitted to the television 136 (represented by signal 641).

Moreover, for live broadcasts (e.g., cable, satellite, Webcast) a user-specified amount of the MPEG-2 data will be stored directly in buffer 610 and

streamed to the television 135 through the MPEG-2 decompression module 130 (represented by signal 640), thereby providing support for real-time “trick modes” such as pause or rewind for live television. As described above, the amount of data stored in the 20:1 compressed data buffer 610 for these purposes
5 may be based on the capacity of the mass storage device employed on the system.

Moreover, in one embodiment, users may select a compression *type* for recorded multimedia programs (i.e., other than the compression type with which the digital signal was broadcast). For example, new compression algorithms
10 such as MPEG-4 and Real Video 8 will achieve a significantly higher compression ratio at the same quality level as MPEG-2. As such, by selecting one of these new compression types, users can free up space on the mass storage device 120 while maintaining the same level of video image quality. Moreover, certain compression types (e.g., Real Video 8) are designed to perform video
15 compression in real time on a general purpose CPU. As indicated in **Figure 5**, if one of these CPU-based compression algorithms are selected, the digital content will be read from the storage buffer 612 and decompressed in real-time by the CPU rather than the MPEG-2 decompression module 130.

In other respects, the system works in a similar manner as described
20 above with respect to compression ratio conversion. When the user selects the recorded program for viewing, it will be streamed to his television from buffer

612, and decompressed by the CPU. If, as described above, the entire background process is not complete when the viewer selects the recorded program (i.e., if only a portion of the data has been converted to the new compression type), then the portion of the data in buffer 612 will initially be transmitted to the television (or other display device) until all of the newly-compressed data has been consumed. Then, the remaining portion of the data residing in the standard compression buffer 611 will be transmitted to the television 136 as represented by signal 641. Similarly, for live broadcasts (e.g., cable, satellite, Webcast) a user-specified amount of the MPEG-2 data will be stored directly in buffer 610 and streamed to the television 135 through the MPEG-2 decompression module 130 (represented by signal 640), thereby providing support for real-time "trick modes" such as pause or rewind for live television.

As described above, certain compression algorithms such as Real Video 8 may be executed in real time on a general purpose CPU. Accordingly, **Figure 7a** illustrates one embodiment of the invention in which analog video signals 101, 102, after being digitized/decoded, are immediately compressed by the CPU using one of these compression algorithms and stored on the mass storage device 120. Similarly, digital signals 103 may be transmitted by cable and satellite operators using the improved compression algorithm and stored directly on the mass storage device 120, thereby conserving communication bandwidth and storage device 120 space due to the improved data compression ratios.

Moreover, as illustrated, no dedicated compression modules and associated memory are required to perform compression and decompression, thereby significantly decreasing manufacturing costs.

As with prior embodiments, users may choose higher or lower compression ratios for recorded multimedia content to conserve space on the mass storage device 120. The user-selected compression ratios may be implemented immediately on the analog signals 101, 102. With respect to the digital signals 103, if the compression ratio selected by the user is different from the compression ratio with which the data is broadcast, then one embodiment of the system will operate as described above, converting the data to the new compression ratio by decompressing and then recompressing the data.

In one embodiment illustrated in **Figure 7b**, a light compression module 410 may also be configured in the system to compress the multimedia content in real time before it is stored on the mass storage device 120. The CPU may then work in the background to compress the data using a different algorithm (e.g., Real Video 8). This embodiment is may be employed to free up processing power for other tasks such as compressing/decompressing other multimedia content (e.g., the digital video input 103) using a more processor-intensive compression algorithm. In one embodiment, the light compression module 410 may be used to compress data to support “trick” modes for live broadcasts (e.g., wherein a predetermined amount of live data is stored to support functions such

as “pause” and “rewind”), whereas the standard compression and decompression implemented by the CPU may be used for long term multimedia storage.

In one embodiment, illustrated in **Figure 7c**, both MPEG-2 data and/or non-MPEG-2 data (i.e., signal 771) may be transmitted by the multimedia content provider. Accordingly, this embodiment may include an MPEG-2 decompression module 130 for decompressing the MPEG-2 data in addition to the CPU real-time decompression 720 and/or light decompression module 420. As such, this embodiment may be employed by a variety of different content providers (e.g., digital cable, satellite, Webcast, digital broadcast, . . . etc) regardless of the format in which the content provider transmits the underlying multimedia content. Once again, in one embodiment, the light compression module 410 may be used to compress data for “trick” modes for live broadcasts, whereas the standard compression and decompression (both MPEG-2 and non-MPEG-2) may be used for long term multimedia storage.

In one embodiment, the multimedia content stored in the “trick mode” uncompressed data buffers described herein (e.g., buffer 310) may also be compressed in the background by the CPU and stored in a compressed trick mode buffer (not shown). Similarly, multimedia content may be stored in a first trick mode buffer at a first compression ratio/type (e.g., at which it was transmitted by the multimedia content broadcaster), converted as a background

task by the CPU to a second compression ratio/type and stored in a second trick mode buffer. Accordingly, the same techniques described herein with respect to long term multimedia storage may also be applied to live multimedia storage and trick modes (e.g., conversion from one compression ratio/type to another, compressing/ decompressing in real time using a general purpose CPU, . . . etc).

It should be noted, that while the foregoing embodiments were described with respect to specific compression algorithms such as Real Video 8 and MPEG, other CPU-based and non-CPU-based compression algorithms (e.g., MPEG-4, AC-3, . . . etc) may be employed while still complying with the underlying principles of the invention. Moreover, although certain analog and digital embodiments were described separately (e.g., in **Figure 2** and **Figure 5**, respectively), it will be readily apparent to one of ordinary skill in the art that these embodiments may be combined in a single system (i.e., capable of receiving and processing both analog and digital signals using the techniques set forth above).

Moreover, it will be appreciated that several multimedia streams may be processed concurrently by the system (depending, in part, on the speed at which the mass storage device can read/write data). For example, two live streams may be transmitted concurrently through two separate "trick mode" buffers. At the same time, two recorded streams may be temporarily stored in interim buffers and processed in the background by the CPU (e.g., from a first

compression ratio/type to a second compression ratio type). In addition, the streams may be transmitted from the multimedia storage system to the rendering devices (e.g., televisions) over a variety of different data transmission channels/media, including both terrestrial cable (e.g., Ethernet) and wireless
5 (e.g., 802.11b).

Embodiments of the present invention include various steps, which have been described above. The steps may be embodied in machine-executable instructions which may be used to cause a general-purpose or special-purpose processor to perform the steps. Alternatively, these steps may be performed by
10 specific hardware components that contain hardwired logic for performing the steps, or by any combination of programmed computer components and custom hardware components.

Elements of the present invention may also be provided as a computer program product which may include a machine-readable medium having stored
15 thereon instructions which may be used to program a computer (or other electronic device) to perform a process. The machine-readable medium may include, but is not limited to, floppy diskettes, optical disks, CD-ROMs, and magneto-optical disks, ROMs, RAMs, EPROMs, EEPROMs, magnet or optical cards, propagation media or other type of media/machine-readable medium
20 suitable for storing electronic instructions. For example, the present invention may be downloaded as a computer program product, wherein the program may

be transferred from a remote computer (e.g., a server) to a requesting computer (e.g., a client) by way of data signals embodied in a carrier wave or other propagation medium via a communication link (e.g., a modem or network connection).

5 Throughout the foregoing description, for the purposes of explanation, numerous specific details were set forth in order to provide a thorough understanding of the present system and method. It will be apparent, however, to one skilled in the art that the system and method may be practiced without some of these specific details. In other instances, well known structures and
10 functions were not described in detail in order to avoid obscuring the subject matter of the present invention. Accordingly, the scope and spirit of the invention should be judged in terms of the claims which follow.

CLAIMS

What is claimed is:

1 1. A multimedia apparatus comprising:
2 a mass storage device to store uncompressed and compressed multimedia
3 content; and
4 compression logic executed by a processor, said compression logic
5 configured to
6 store uncompressed multimedia content in an interim multimedia buffer
7 on said mass storage device,
8 compress said uncompressed multimedia content as a background task to
9 generate compressed multimedia content responsive to a user request to record
10 said multimedia content, and
11 store said compressed multimedia content in long term multimedia buffer
12 on said mass storage device.

1 2. The multimedia apparatus as in claim 1 wherein said compression
2 logic is further configured to:
3 stream said compressed multimedia content from said long term
4 multimedia buffer to a decompression module and then to a multimedia
5 rendering device responsive to a user request to view said multimedia content.

1 3. The multimedia apparatus as in claim 2 wherein said compression
2 logic is further configured to:
3 automatically stream said uncompressed multimedia content remaining in
4 said interim multimedia buffer directly to said multimedia rendering device once
5 said compressed multimedia content stored in said long term multimedia buffer
6 has been streamed to said rendering device.

1 4. The multimedia apparatus as in claim 1 wherein said multimedia
2 content is broadcast video content.

1 5. The multimedia apparatus as in claim 4 wherein said broadcast video
2 content is transmitted from a cable television provider.

1 6. The multimedia apparatus as in claim 4 wherein said broadcast video
2 content is a Webcast transmitted over a data network.

1 7. The multimedia apparatus as in claim 1 further comprising:
2 light compression logic configured to compress said multimedia signal
3 before said multimedia signal is stored in said interim multimedia buffer.

1 8. The multimedia apparatus as in claim 7 wherein said light
2 compression logic is adaptive differential pulse code modulation ("ADPCM")
3 logic.

1 9. The multimedia apparatus as in claim 7 wherein said light
2 compression logic is digital video ("DV25") compression.

1 10. A computer-implemented method for decreasing the cost of a
2 multimedia storage device comprising:
3 storing multimedia content in an interim multimedia buffer on a mass
4 storage device before compressing said multimedia content;
5 compressing said multimedia content as a background task to generate
6 compressed multimedia content responsive to a user request to record said
7 multimedia content; and

8 storing said compressed multimedia content in long term multimedia
9 buffer on said mass storage device.

1 11. The method as in claim 10 further comprising streaming said
2 compressed multimedia content from said long term multimedia buffer to a
3 decompression module and then to a multimedia rendering device responsive to
4 a user request to view said multimedia content.

1 12. The method as in claim 11 further comprising automatically streaming
2 said uncompressed multimedia content remaining in said interim multimedia
3 buffer directly to said multimedia rendering device once said compressed
4 multimedia content stored in said long term multimedia buffer has been
5 streamed to said rendering device, if any uncompressed multimedia content
6 remains in said interim data buffer when said long term storage buffer is empty.

1 13. The method as in claim 10 wherein said multimedia content is
2 broadcast video content.

1 14. The method as in claim 13 wherein said broadcast video content is
2 transmitted from a cable television provider.

1 15. The method as in claim 13 wherein said broadcast video content is a
2 Webcast transmitted over a data network.

1 16. The method as in claim 10 further comprising compressing said
2 multimedia content in real-time using light compression logic before said
3 multimedia content is stored in said interim multimedia buffer.

1 17. The method as in claim 16 wherein said light compression logic is
2 adaptive differential pulse code modulation ("ADPCM") logic.

1 18. The method as in claim 16 wherein said light compression logic is
2 digital video ("DV25") compression.

1 19. A method implemented on a multimedia storage apparatus
2 comprising:

3 storing compressed multimedia content in an interim storage buffer at a
4 first compression ratio, said first compression ratio being that at which said
5 compressed multimedia content was transmitted by a multimedia content
6 broadcaster;

7 converting said compression ratio of said compressed multimedia content
8 from said first compression ratio to a second compression ratio; and

9 storing said multimedia content compressed at said second compression
10 ratio in a long term storage buffer.

1 20. The method as in claim 19 wherein converting comprises:

2 decompressing said multimedia content compressed at said first
3 compression ratio; and

4 recompressing said multimedia content at said second compression ratio,
5 said second compression ratio being higher than said first compression ratio.

1 21. The method as in claim 19 wherein converting said compressed
2 multimedia content to compressed multimedia content at said second
3 compression ratio is performed by a CPU as a background task.

1 22. The method as in claim 19 wherein said compressed multimedia
2 content at said first compression ratio is DV25-compressed and said compressed
3 multimedia content at said second compression ratio is MPEG1-, MPEG2- or
4 MPEG4-compressed.

1 23. The method as in claim 19 further comprising streaming said
2 multimedia content from said long term storage buffer to a decompression
3 module and then to a multimedia rendering device responsive to a user request
4 to view said multimedia content.

1 24. The method as in claim 19 further comprising automatically streaming
2 said multimedia content remaining in said interim storage buffer to a
3 decompression module once said compressed multimedia content stored in said
4 long term storage buffer has been streamed to said rendering device, if any
5 multimedia content remains in said interim storage buffer when said long term
6 storage buffer is empty.

1 25. The method as in claim 19 wherein said multimedia content is
2 broadcast video content.

1 26. The method as in claim 22 wherein said broadcast video content is
2 transmitted from a cable television provider.

1 27. The method as in claim 22 wherein said broadcast video content is a
2 Webcast transmitted over a data network.

1 28. A method implemented on a multimedia storage apparatus
2 comprising:

3 storing multimedia content compressed using a first compression type in
4 an interim storage buffer, said first compression type being that at which said
5 compressed multimedia content was transmitted by a multimedia content
6 broadcaster;

7 converting said compression type of said multimedia content from said
8 first compression type to a second compression type; and

9 storing said multimedia content compressed using said second
10 compression type in a long term storage buffer.

1 29. The method as in claim 28 wherein converting comprises:

2 decompressing said multimedia content compressed using said first
3 compression type; and

4 recompressing said multimedia content using said second compression
5 type, said second compression type providing relatively greater compression
6 than said first compression type.

1 30. The method as in claim 28 wherein converting is performed by a CPU
2 as a background task.

1 31. The method as in claim 28 wherein said first compression type is
2 DV25 compression and said second compression type is MPEG-1, MPEG-2 or
3 MPEG-4.

1 32. The method as in claim 28 further comprising streaming said
2 multimedia content from said long term storage buffer to a decompression
3 module and then to a multimedia rendering device responsive to a user request
4 to view said multimedia content.

1 33. The method as in claim 28 further comprising automatically streaming
2 said multimedia content remaining in said interim storage buffer to a
3 decompression module once said compressed multimedia content stored in said
4 long term storage buffer has been streamed to said rendering device, if any
5 multimedia content remains in said interim storage buffer when said long term
6 storage buffer is empty.

1 34. The method as in claim 28 wherein said multimedia content is
2 broadcast video content.

1 35. The method as in claim 34 wherein said broadcast video content is
2 transmitted from a cable television provider.

1 36. The method as in claim 34 wherein said broadcast video content is a
2 Webcast transmitted over a data network.

1 37. The method as in claim 34 wherein said broadcast video content is
2 transmitted from a satellite content provider.

1 38. The method as in claim 34 wherein decompression of said multimedia
2 content compressed at said second compression type is performed in real time by
3 a general purpose processor.

1 39. The method as in claim 28 wherein said first compression type is
2 MPEG-2 and said second compression type is Real Video 8.

1 40. A method for providing trick modes and long term storage on a
2 multimedia storage device comprising:

3 storing first multimedia content in an trick mode data buffer on a mass
4 storage device, said trick mode data buffer storing said first multimedia content
5 in a compression format and ratio at which said first multimedia content was
6 transmitted;

7 storing second multimedia content identified for long term storage in an
8 interim multimedia buffer on said mass storage device in a compression format
9 and ratio at which said second multimedia content was transmitted;

10 converting said second multimedia content as a background task to a
11 user-specified compression format and/or compression ratio to generate
12 compressed second multimedia content responsive to a user request to record
13 said multimedia content; and

14 storing said compressed multimedia content in long term multimedia
15 buffer on said mass storage device.

1 41. The method as in claim 40 further comprising streaming said first
2 multimedia content from said trick mode data buffer to a decompression module
3 and then to a multimedia rendering device responsive to a user request to view
4 said multimedia content.

1 42. The method as in claim 40 wherein said first multimedia content is a
2 live multimedia broadcast.

1 43. The method as in claim 40 further comprising stopping streaming said
2 first multimedia content responsive to a user command to stop said streaming
3 while at the same time continually storing additional live incoming multimedia
4 content in said trick mode data buffer.

1 44. The method as in claim 42 wherein said live multimedia broadcast is a
2 Webcast transmitted over a data network.

1 45. The method as in claim 40 further comprising compressing said
2 multimedia content in real-time using light compression logic before said
3 multimedia content is stored in said interim multimedia buffer.

1 46. A system for storing and playing back multimedia content
2 comprising:
3 first compression means for compressing an incoming multimedia signal
4 in real-time to produce first-compressed multimedia content;
5 first storage means for storing said first-compressed multimedia content;
6 conversion means for converting said first-compressed multimedia
7 content to second-compressed multimedia content having a different
8 compression ratio and/or a different compression type than said first-
9 compressed multimedia content; and
10 second storage means for storing said second-compressed multimedia
11 content.

1 47. The system as in claim 46 further comprising:
2 first decompression means for decompressing said second-compressed
3 multimedia content prior to transmitting said multimedia content to a
4 multimedia rendering device.

1 48. The system as in claim 47 further comprising:
2 second decompression means for decompressing said first-compressed
3 multimedia content after said second-compressed multimedia content has been
4 decompressed and transmitted.

1 49. The system as in claim 46 wherein said first compression means
2 comprises intra-frame coding and said second compression means comprises
3 inter-frame coding.

1 50. The system as in claim 49 wherein said intra-frame coding is DCT
2 coding and said inter-frame coding comprises motion compensation and frame
3 differencing.

1 51. The system as in claim 49 wherein said intra-frame coding utilizes
2 ADPCM compression and said inter-frame coding utilizes DCT-based
3 compression.

1 52. The system as in claim 46 wherein said conversion means comprises a
2 general purpose CPU executing a compression algorithm as a background task.

1 53. The system as in claim 52 wherein said conversion means further
2 comprises one or more swap files utilized by said CPU during execution of said
3 compression algorithm.

ABSTRACT

A multimedia apparatus is described comprising: a mass storage device to store uncompressed and compressed multimedia content; and compression logic executed by a processor, the compression logic configured to store
5 uncompressed multimedia content in an interim multimedia buffer on the mass storage device, compress the uncompressed multimedia content as a background task to generate compressed multimedia content, and store the compressed multimedia content in long term multimedia buffer on the mass storage device.

Also described is a computer-implemented method for decreasing the cost
10 of a multimedia storage device comprising: storing multimedia content in an interim multimedia buffer on a mass storage device before compressing the multimedia content; compressing the multimedia content as a background task to generate compressed multimedia content responsive to a user request to record the multimedia content; and storing the compressed multimedia content
15 in long term multimedia buffer on the mass storage device.

Also described is a method implemented on a multimedia storage apparatus comprising: storing digital multimedia content in an interim storage buffer at a first compression ratio, the first compression ratio being the ratio at which the digital multimedia content was transmitted by a multimedia content
20 broadcaster; decompressing the multimedia content; recompressing the multimedia content at a second compression ratio specified by a user, the second

compression ratio being higher than the first compression ratio; and storing the recompressed multimedia content in a long term storage buffer.

Also described is a method implemented on a multimedia storage apparatus comprising: storing digital multimedia content in an interim storage buffer at a first compression type, the first compression type being the type at which the digital multimedia content was transmitted by a multimedia content broadcaster; decompressing the multimedia content; recompressing the multimedia content using a second compression type specified by a user to create recompressed multimedia content; and storing the recompressed multimedia content in a long term storage buffer.

FIG. 1a is a block diagram of a system architecture for a video processing system. The system includes a video input (Video in 101) connected to a Tuner (105). The Tuner (105) is connected to a Decoder & Digitizer (110). The Decoder & Digitizer (110) is connected to an MPEG-2 Compression (115) block. The MPEG-2 Compression (115) block is connected to a Mass Storage (120) block. The Mass Storage (120) block is connected to an MPEG-2 Decompression (130) block. The MPEG-2 Decompression (130) block is connected to a TV (135). The system also includes Main Memory (126) connected to a CPU (125). The CPU (125) is connected to the Mass Storage (120). The Mass Storage (120) is connected to the MPEG-2 Decompression (130). The MPEG-2 Decompression (130) is connected to the TV (135). The system also includes two 8 Meg SDRAM (116) blocks, one connected to the MPEG-2 Compression (115) and one connected to the MPEG-2 Decompression (130).

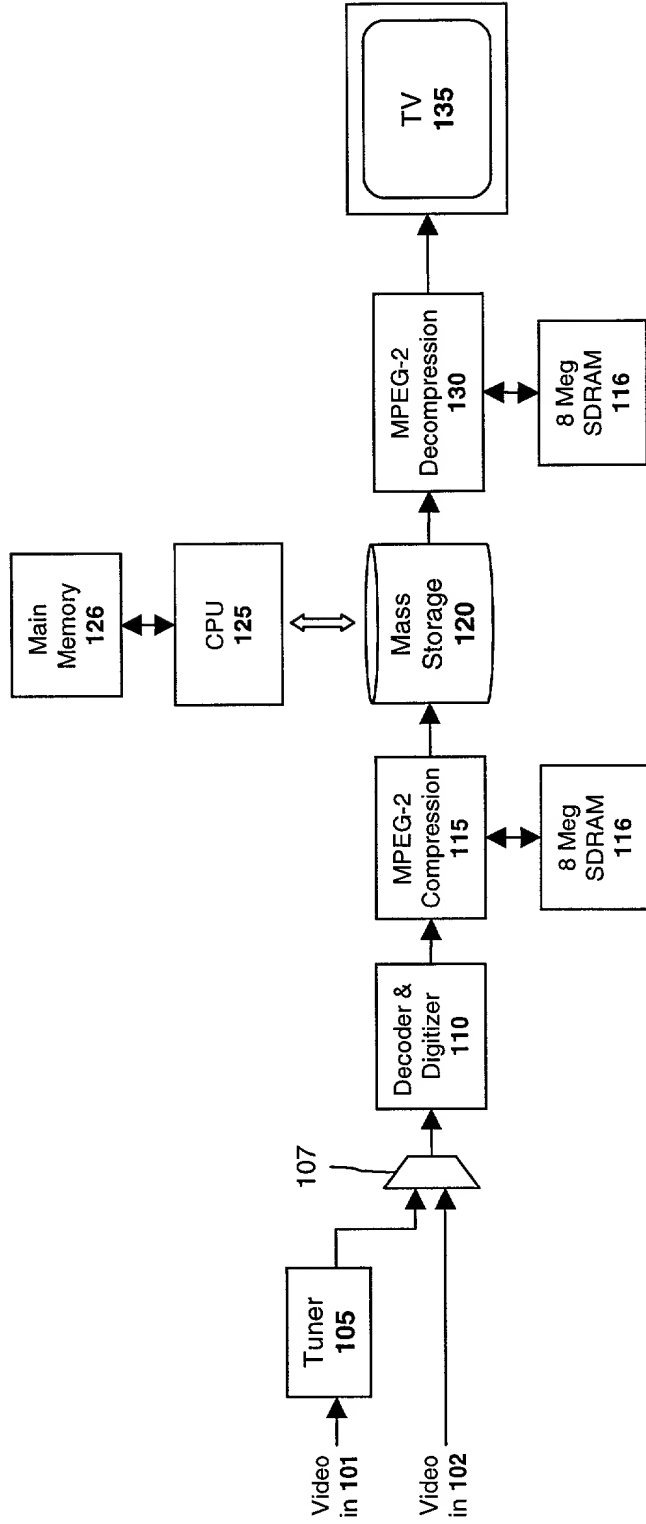


FIG. 1a
(prior art)

FIG. 1b is a block diagram of a system for processing digital video data. The system includes a digital video input 103, a QAM modulator 150, a CA (Conditional Access) module 160, an MPEG-2 data stream 170, a Mass Storage unit 120, a CPU 125, Main Memory 126, an MPEG-2 Decompression module 130, 8 Meg SDRAM 116, and a TV 135. The digital video input 103 is connected to the QAM modulator 150. The QAM modulator 150 is connected to the CA module 160. The CA module 160 outputs the MPEG-2 data stream 170 to the Mass Storage unit 120. The Mass Storage unit 120 is connected to the CPU 125 and Main Memory 126. The CPU 125 and Main Memory 126 are connected to the MPEG-2 Decompression module 130. The MPEG-2 Decompression module 130 is connected to the 8 Meg SDRAM 116 and the TV 135.

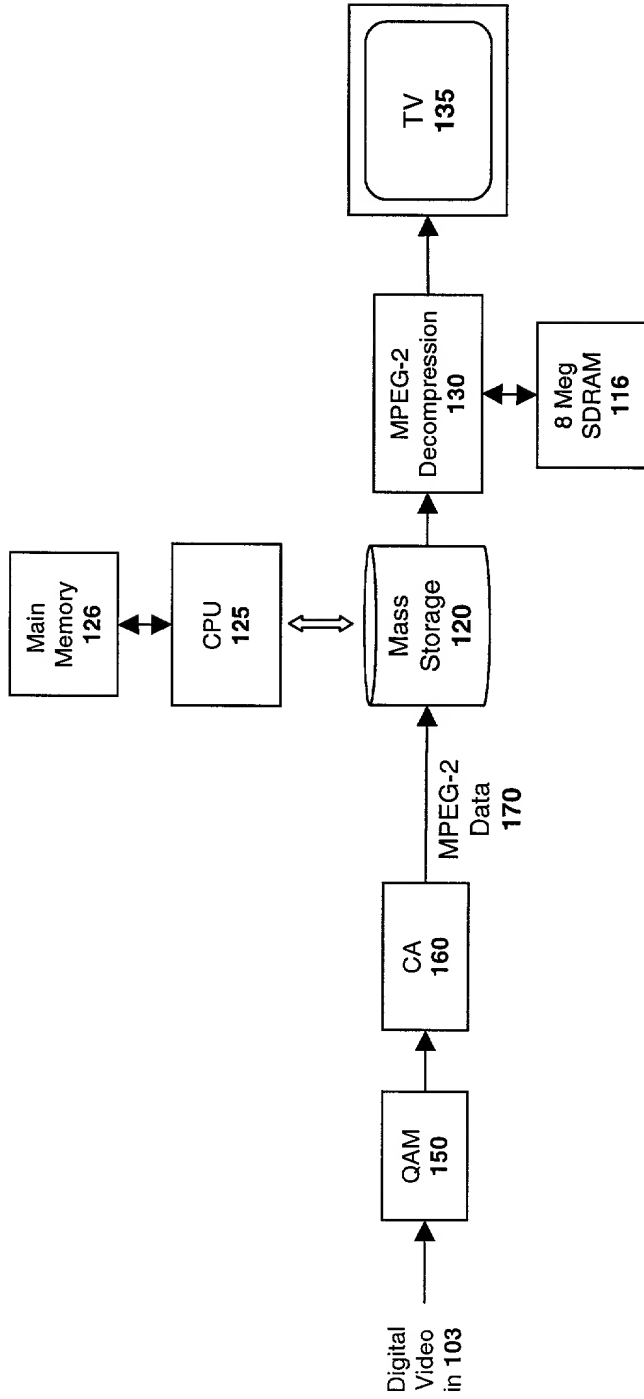


FIG. 1b
(prior art)

FIG. 2 is a block diagram of a system 100 for processing video data. The system 100 includes a video input 101, a tuner 105, a decoder/digitizer 110, a mass storage 120, a compression module 210, a CPU 225, a main memory 226, a bypass 220, a decompression module 130, an 8 Meg SDRAM 116, and a TV 135. The video input 101 is connected to the tuner 105, which is connected to the decoder/digitizer 110. The decoder/digitizer 110 is connected to the mass storage 120. The mass storage 120 is connected to the compression module 210. The compression module 210 is connected to the CPU 225. The CPU 225 is connected to the main memory 226. The CPU 225 is also connected to the bypass 220. The bypass 220 is connected to the decompression module 130. The decompression module 130 is connected to the 8 Meg SDRAM 116. The 8 Meg SDRAM 116 is connected to the TV 135.

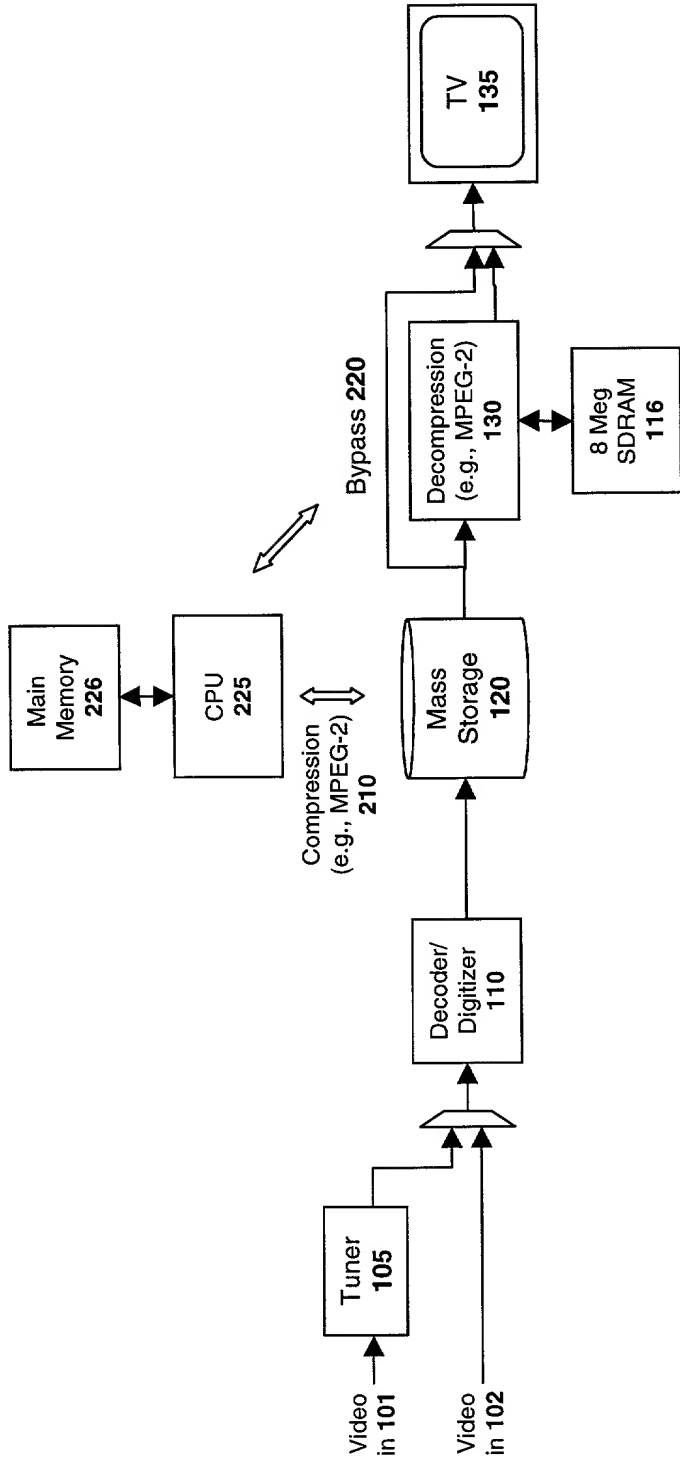


FIG. 2

FIG. 3 is a block diagram of a system for processing video data. The system includes a CPU 125 and Main Memory 126, which are connected to a Mass Storage 120. The Mass Storage 120 contains an Uncompressed Data Buffer 311 and a Compressed Data Buffer 312. The Uncompressed Data Buffer 311 is connected to a Video In 301 and a Video In 300. The Compressed Data Buffer 312 is connected to a TV 135 and a TV 136. The system also includes a Compression (e.g., MPEG-2) block that receives data from the Uncompressed Data Buffer 311 and outputs data to the Compressed Data Buffer 312. The TV 135 receives a Signal 340 from the Uncompressed Data Buffer 311. The TV 136 receives a Signal 341 from the Uncompressed Data Buffer 311 and a Signal 342 from the Compressed Data Buffer 312.

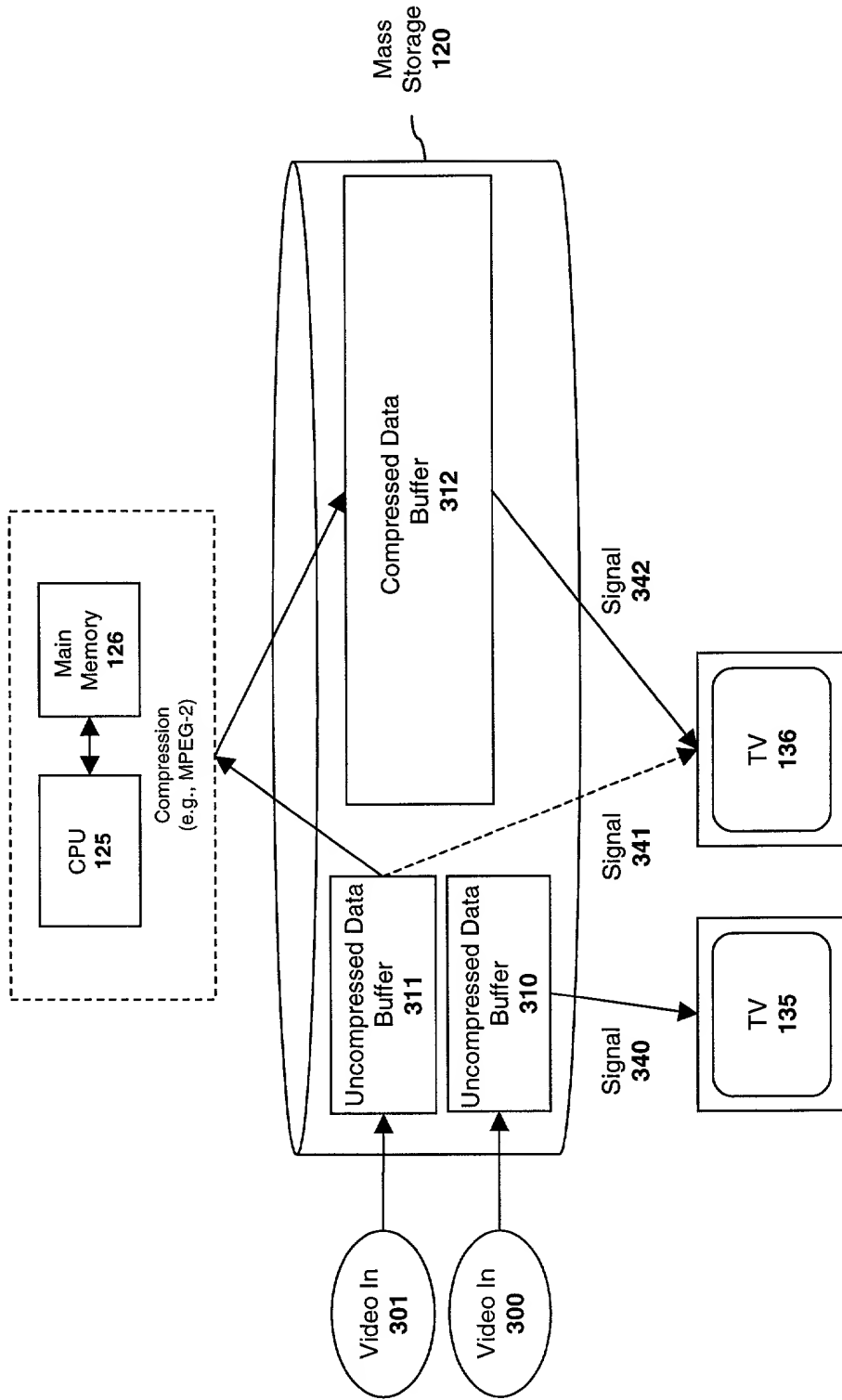


FIG. 3

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graph LR
    Video([Video in 101, 102]) --> Decoder[Decoder/Digitizer 110]
    Decoder --> Comp1[Light Compression 410  
(e.g., ADPCM, DV25)]
    Comp1 --> Mass[(Mass Storage 120)]
    Mass --> Comp2[Compression  
(e.g., MPEG-2)]
    Comp2 <--> CPU[CPU 125]
    CPU <--> Mem[Main Memory 126]
    CPU --> Decomp1[Light Decompression 420  
(e.g., ADPCM, DV)]
    Comp2 --> Decomp1
    Decomp1 --> Decomp2[Decompression 130  
(e.g., MPEG-2, DV25)]
    Decomp2 <--> SDRAM[8 Meg SDRAM 116]
    Decomp2 --> TV[TV 135]
  
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FIG. 4

FIG. 5 is a block diagram of a system for processing digital video data. The system includes a digital video input 103, a QAM modulator 150, a CA (Conditional Access) module 160, a Mass Storage unit 120, a CPU 125, Main Memory 126, an MPEG-2 Decompression module 130, 8 Meg SDRAM 116, and a TV 135. The digital video input 103 is connected to the QAM modulator 150. The QAM modulator 150 is connected to the CA module 160. The CA module 160 outputs MPEG-2 Data 170 to the Mass Storage unit 120. The Mass Storage unit 120 is connected to the CPU 125 via a Data Compression/Conversion module 510. The CPU 125 is connected to Main Memory 126. The CPU 125 is also connected to the MPEG-2 Decompression module 130 via a CPU Real-Time Decompression module 520. The MPEG-2 Decompression module 130 is connected to the 8 Meg SDRAM 116. The MPEG-2 Decompression module 130 outputs video data to the TV 135.

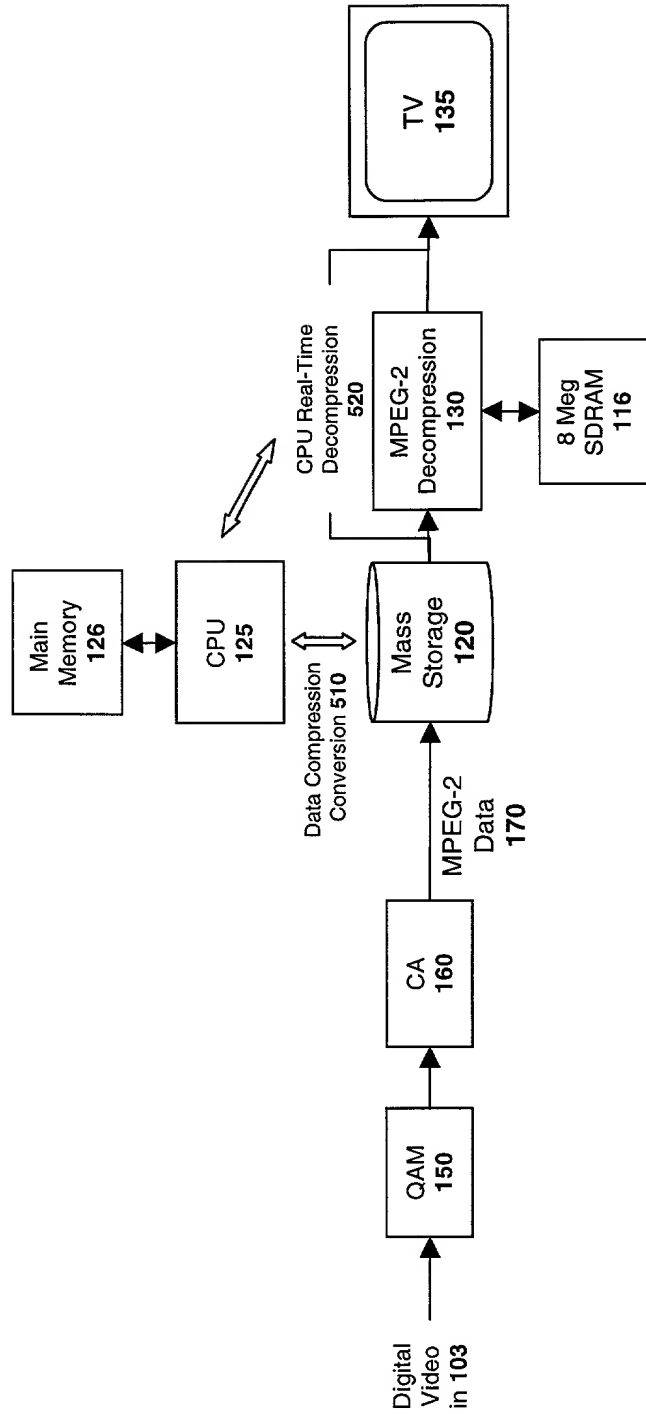
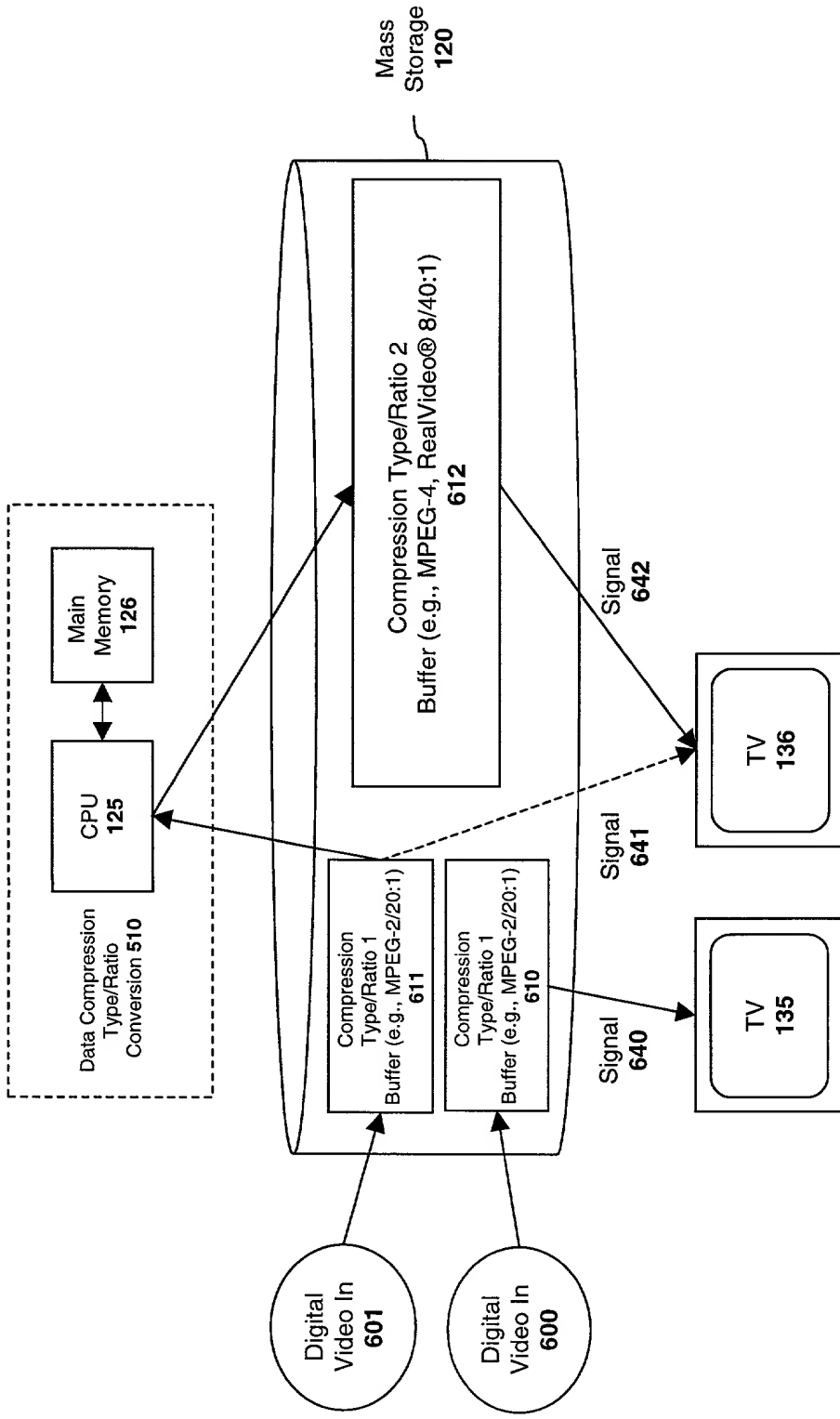


FIG. 5



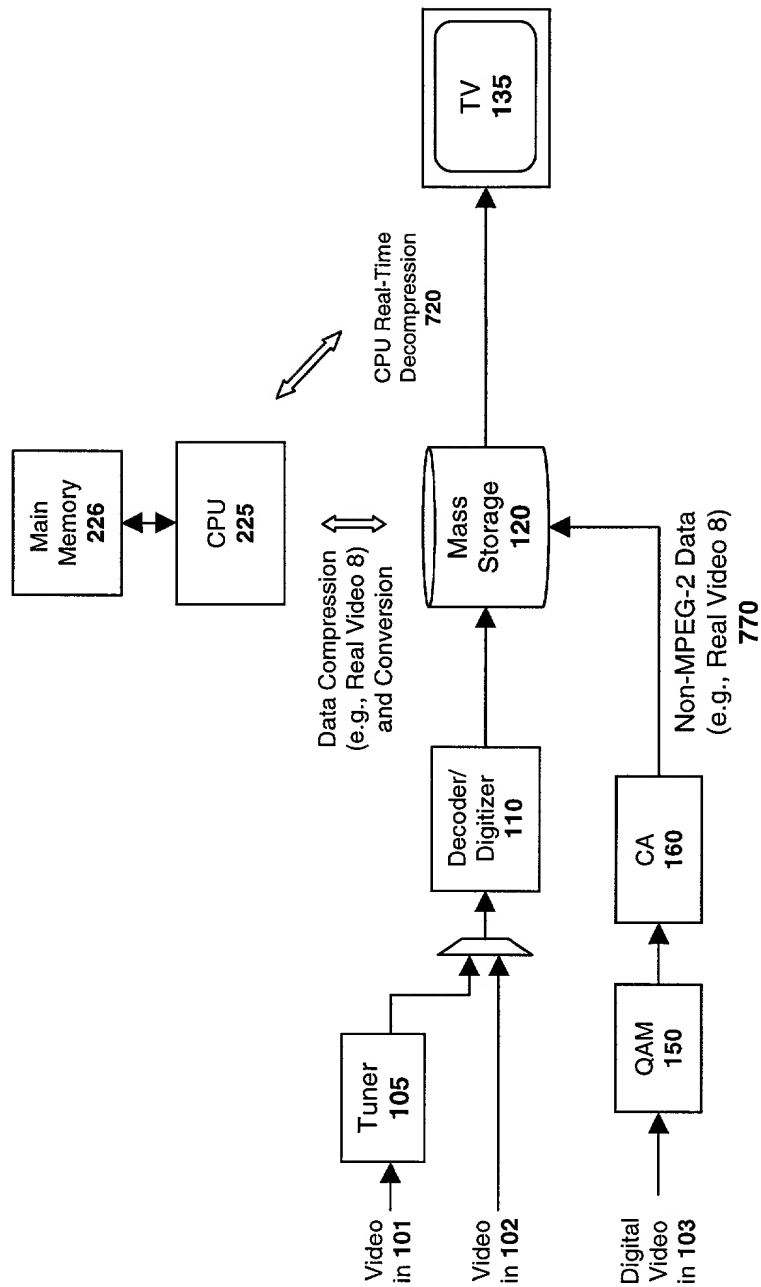


FIG. 7a

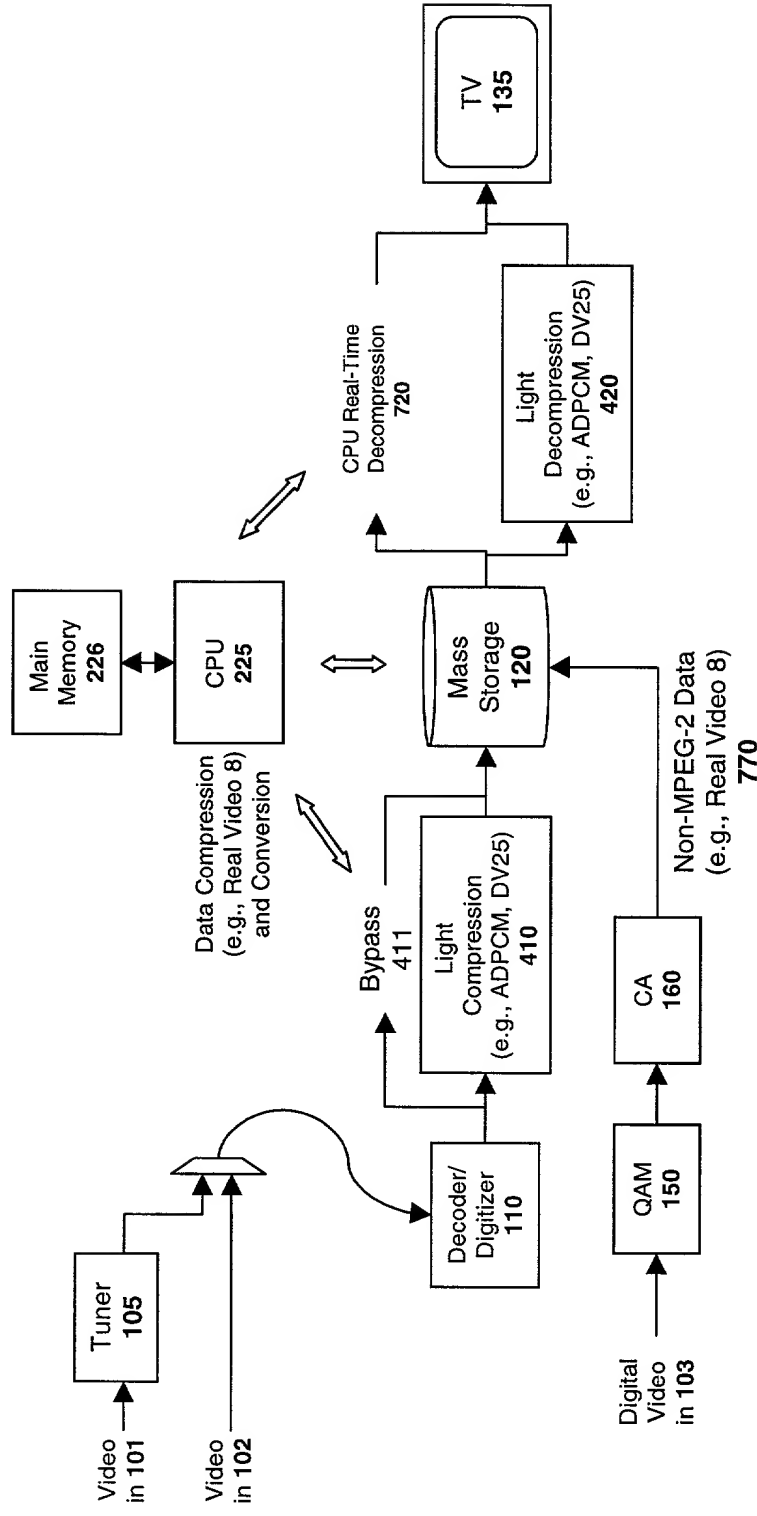


FIG. 7b

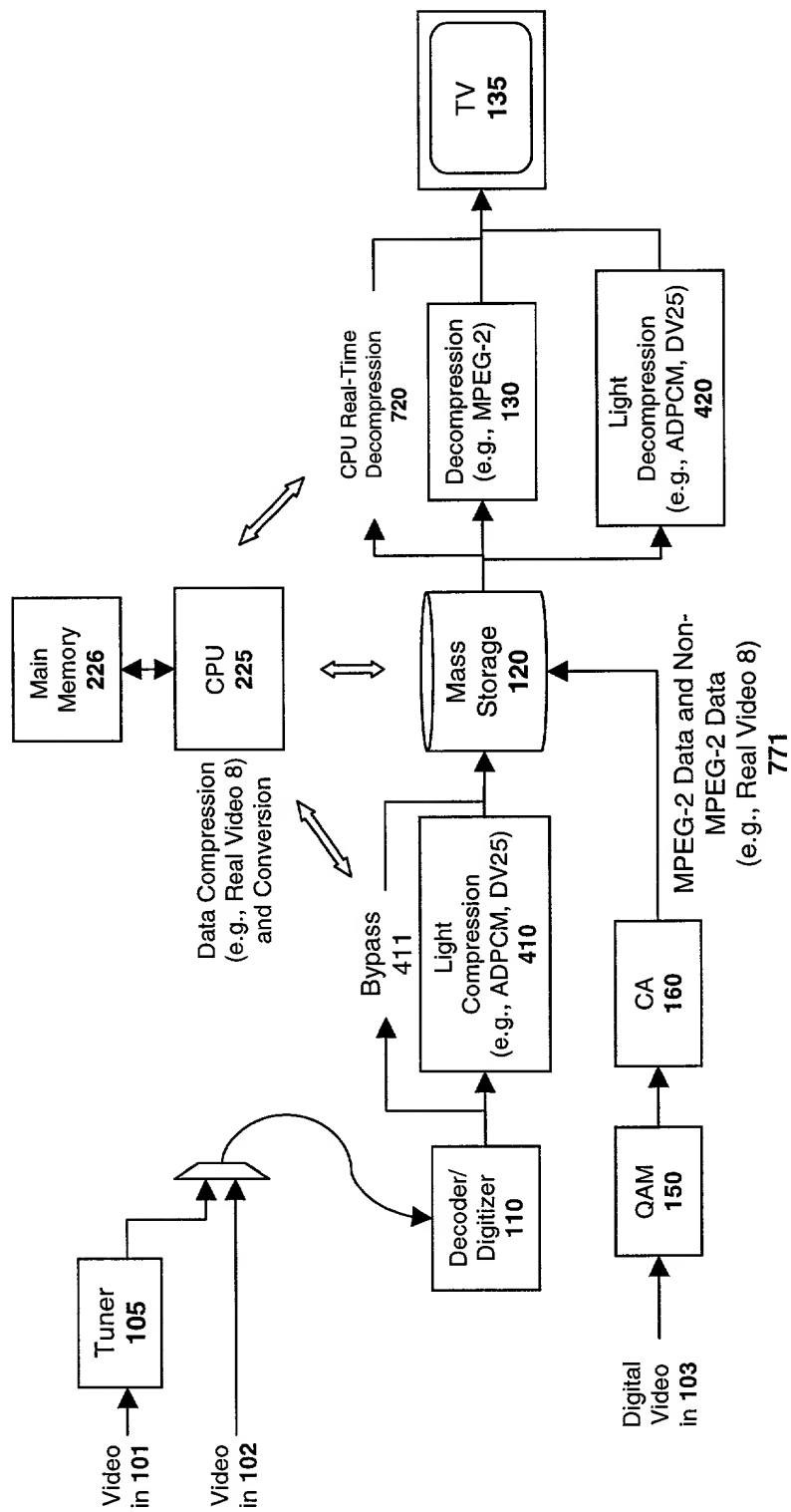


FIG. 7C

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

APPARATUS AND METHOD FOR INTELLIGENT MULTIMEDIA COMPRESSION AND DISTRIBUTION

the specification of which

 X is attached hereto.
_____ was filed on _____ as
United States Application Number _____
or PCT International Application Number _____
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority
Claimed

(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Thomas C. Webster, BLAKELY, SOKOLOFF, TAYLOR &
(Name of Attorney or Agent)
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56 Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) Prior art cited in search reports of a foreign patent office in a counterpart application, and
 - (2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.
- (b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and
- (1) It establishes, by itself or in combination with other information, a *prima facie* case of unpatentability of a claim; or
 - (2) It refutes, or is inconsistent with, a position the applicant takes in:
 - (i) Opposing an argument of unpatentability relied on by the Office, or
 - (ii) Asserting an argument of patentability.

A *prima facie* case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

- (1) Each inventor named in the application;
 - (2) Each attorney or agent who prepares or prosecutes the application; and
 - (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.
- (d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.